

Sadao Haga, *et al.*
U.S.S.N. 09/916,381
Page 4 of 9

REMARKS

Upon entry of this amendment, claims 1-7 are pending in the subject application. Claims 8-13, which were restricted by the Examiner, have been canceled without prejudice or disclaimer. Claim 1 has been amended. Support for this amendment can be found throughout the specification, e.g., at p.10, last four lines. No new matter has been added.

The amendment to the claims does not indicate acquiescence to any rejection; rather, the claims have been amended for the purpose of advancing prosecution. Applicants reserve the right to present the original (or similar) claims in a continuation or divisional application.

Applicants' representatives wish to thank the Examiner for the courtesy of a telephonic interview on December 10, 2004. During the interview, proposed claim amendments were discussed. While a final agreement was not reached, the Examiner agreed to consider the amended claims.

The Invention

An etching solution of the present invention comprises hydrofluoric acid, nitric acid, and hexafluorosilicic acid, the concentration of the hexafluorosilicic acid being 10% to 40% by weight based on the weight of the etching solution.

The Rejection of the Claims

Claims 1-7 have been rejected as unpatentable over Lee (US 6,284,712) in view of Uchida (US 5,307,296). Applicants traverse this rejection.

BOS2_166683_1

Sadao Haga, *et al.*
U.S.S.N. 09/916,381
Page 5 of 9

The teachings of the Lee reference have been discussed previously. In brief, Lee discloses a cleaning composition for cleaning substrates having a silicon oxide layer, that releases fluoride ion into an aqueous solution during cleaning; etching processes for reacting with silicon; and a persulfate which decomposes and releases hydrogen peroxide in the aqueous solution for increasing the oxidation effect of the fluoride.

In Lee, control of the etching reaction is accomplished with the use of fluorides instead of HF. Col. 6, lines 63-66. The etching rate is controlled by adjusting the concentration of the fluorides. Col. 6, lines 66-67. Thus, in Lee, there is generally no need for the use of an inhibitor to control the etching rate.

Indeed, while the Examiner points to the Lee reference at col. 4, lines 10-19, for the proposition that a mixed acid etching solution "also comprises H_2SiF_6 in the mixed acid etchant" (see Office Action at paragraph 4), in fact the cited portion of the Lee reference includes the following statement:

However, as such control is still not sufficient, single crystal silicon wafers are treated with H_2SiF_6 in its saturated concentration in the above mixed acid etchant solution. However, an exothermic reaction occurs in such mixed acid during etching, and the solution temperature increases by 20°C . in reaction time of 1-2 minutes, as the wafer is etched in a magnitude of approximately 30 micro-meters. As such, with the conventional etchants [sic], the chemical activities which occurs during etching is still difficult to control, and as a result, they impart considerable etching damage on silicon wafers.
Lee at col. 4, lines 17-27.

The cited portion of the Lee reference therefore mentions only a "saturated concentration" of hexafluorosilicic acid in a mixed acid etching solution.

BOS2_4666R3_1

Sadao Haga, *et al.*
U.S.S.N. 09/916,381
Page 6 of 9

The pending claims, as amended, recite that the concentration of hexafluorosilicic acid in the solution is in the range of 10% to 40% by weight. Applicants submit that the concentration of a saturated solution of hexafluorosilicic acid is greater than 40%. For example, *Lange's Handbook of Chemistry* (J.A. Dean, Ed.), 13th Ed. (1985) (hereinafter "*Lange's*"), a standard reference text, provides physical data for a solution of hexafluorosilicic acid containing 61% hexafluorosilicic acid by weight (see copy of *Lange's* at page 4-52, attached as Appendix A). Applicants submit that, in view of this reference in *Lange's*, the concentration of a saturated solution of hexafluorosilicic acid must be at least 61% (if not greater). Thus, the cited portion of the Lee reference does not teach a solution according to the pending claims, in which the concentration of hexafluorosilicic acid in the solution is in the range of 10% to 40% by weight.

Moreover, the Lee reference does not teach that addition of H_2SiF_6 (even at a saturated concentration) to a mixed acid etchant solution is sufficient to provide adequate control over the etching process. On the contrary, the Lee reference (at the portion quoted above) states that "the chemical activities which occurs during etching is still difficult to control, and as a result, they impart considerable etching damage on silicon wafers," even with the addition of a saturating concentration hexafluorosilicic acid to the conventional etching solution. In this respect, at least, the Lee reference teaches away from the use of hexafluorosilicic acid in mixed acid etching solutions. Other portions of the Lee reference mention hexafluorosilicic acid as a "toxic H_2SiF_6 reaction product" (see, e.g., col. 10, lines 23 - 26), which the etching solution of Lee seeks to avoid.

BOS2_466683_1

Sadao Haga, *et al.*
U.S.S.N. 09/916,381
Page 7 of 9

As the Lee reference contains no teaching that addition of hexafluorosilicic acid even at a saturated concentration is sufficient to control the etching of the mixed acid etchant solution, it cannot teach or suggest the etching solution of the pending claims, in which the concentration of hexafluorosilicic acid is in the range of 10% to 40% by weight based on the weight of the etching solution. The Lee reference would not motivate one of ordinary skill in the art to use an etching solution containing hexafluorosilicic acid, the concentration of the hexafluorosilicic acid being 10% to 40% by weight based on the weight of the etching solution. Therefore, the Lee reference cannot render obvious the pending claims.

The Uchida reference cannot remedy the deficient teachings of the Lee reference. The Uchida reference has been cited by the Examiner "to show that the altering the etchant concentration results in the etchant concentration being a so-called 'result-effective variable.'" However, as discussed above, the Lee reference does not contain an effective teaching that addition of hexafluorosilicic acid, in the amounts recited by the pending claims, is effective to control the etching reaction. Accordingly, even if Uchida teaches that *etchant concentration* is a "result-effective variable," Uchida does not provide any teaching, whether alone or in combination with Lee, that the addition of *hexafluorosilicic acid* to a mixed acid etchant solution would have been obvious to one of ordinary skill in the art, or that the selection of the claimed concentration of hexafluorosilicic acid would have been obvious to the skilled artisan.

The citation of *In re Boesch* does not change this conclusion. The holding in Boesch cited by the Examiner is that "discovery of an optimum value of a result effective variable *in a known process* is ordinarily within the skill of the art." *Boesch*,

BOS3_466683_1

Sadao Haga, *et al.*
U.S.S.N. 09/916,381
Page 8 of 9

205 USPQ 215 at 219 (emphasis added). As discussed in the MPEP, "a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." MPEP 2144.05, citing *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). In the present case, even if the concentration of *etchant* is a "result-effective variable," the cited art does not teach selection of an effective concentration of *hexafluorosilicic acid*. The concentration of *hexafluorosilicic acid* in the etchant solution therefore cannot be a result-effective variable, as the Examiner has characterized it. As the CCPA stated in *In re Antonie*:

"the discovery of an optimum value of a variable in a known process is normally obvious. We have found exceptions to this rule in cases where the results of optimizing a variable, which was known to be result effective, were unexpectedly good... This case, in which the parameter optimized was not recognized to be a result-effective variable, is another exception."

Thus, when a particular parameter is *not* recognized to be a result-effective variable, the holding of *Boesch* does not apply. In the present case, the claims recite a specified concentration of hexafluorosilicic acid – not a known result-effective parameter in the context of etching solutions, as described above – and the *Boesch* analysis is inapplicable. Applicants respectfully contend that the cited references, whether alone or in combination, do not render obvious the claimed invention.

For at least the above reasons, reconsideration and withdrawal of this rejection is proper and the same is requested.

BOS2_466GR3_1

Sadao Haga, *et al.*
U.S.S.N. 09/916,381
Page 9 of 9

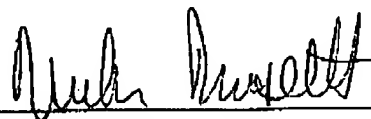
Conclusion

It is respectfully submitted that the present application is in condition for allowance. An early consideration and notice of allowance are earnestly solicited.

In the event that an extension of time is required for this response to be considered timely submitted, the undersigned hereby conditionally petitions for any extension of time necessary. It is not believed any additional fees are required; however, if an additional fee is required, or if an overpayment is made, please charge/credit our deposit account 04-1105.

Respectfully submitted,

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